Assessing PLM's Capabilities in Support of MBSE Model-Based Systems Engineering - Workshop

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Peter A. Bilello, President & CEO
email: p.bilello@cimdata.com
Tel: +1.734.668.9922

CIMdata® | Global Leaders in PLM Consulting
www.CIMdata.com

Peter A. Bilello, President & CEO

Professional background

- More than 30 years of experience in the development of IT solutions for research, engineering, and manufacturing organizations worldwide
- Led numerous projects in PLM analysis, selection, implementation & management, synchronous and lean manufacturing consulting & software engineering, as well as general data management & governance strategy development and support
- Authored many papers & research reports on PLM and related topics, as well as numerous articles, commentaries, and perspectives that have appeared in publications throughout the NA, EMEA & Asia
- Holds a B.S. in Computer Science (minor in Physics) & M.S.E. in Manufacturing Systems Engineering

CIMdata's Mission...

Strategic management consulting for competitive advantage in global markets

CIMdata is the leading independent global strategic management consulting and research authority focused exclusively on PLM and the digital transformation it enables.

We are dedicated to maximizing our clients' ability to design, deliver, and support innovative products and services through the application of PLM.

Key Takeaways

Assessing PLM's Capabilities in Support of MBSE

- Today's digital transformation initiatives, such as MBSE, require a holistic and integrated application approach—one that supports a business' strategy & business objectives, while maximizing their return on investment
- A comprehensive enterprise information capabilities model can be used to assess MBSE enabling capabilities
- Identifying and assessing an organization's required MBSE enabling capabilities is multi-faceted, with capabilities cutting across traditional and non-traditional data & process management areas
- An enterprise information capabilities model can also be used to define requirements and implementation plans
- A good enterprise information capabilities model will evolve over time

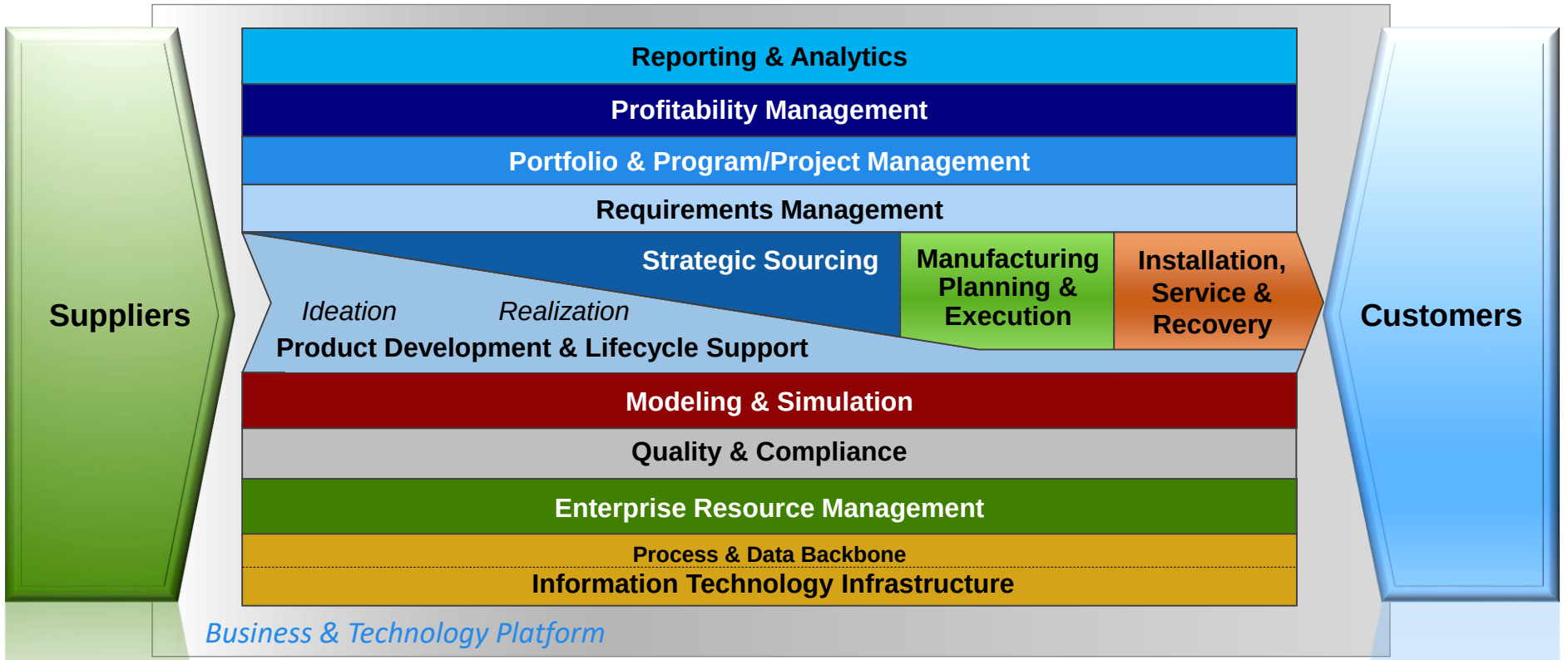
Agenda

- CIMdata's Enterprise Application Architecture Assessment Model
- EAA Focus Areas that Support MBSE
- EAA Maturity Assessment Results
- Concluding Remarks

CIMdata's Enterprise Application Architecture™

Enterprise Application Architecture begins with an Information Capabilities Model

Information Capabilities Model



Capability means the information technology and processes required to accomplish a business function with input from suppliers and deliver to customers.

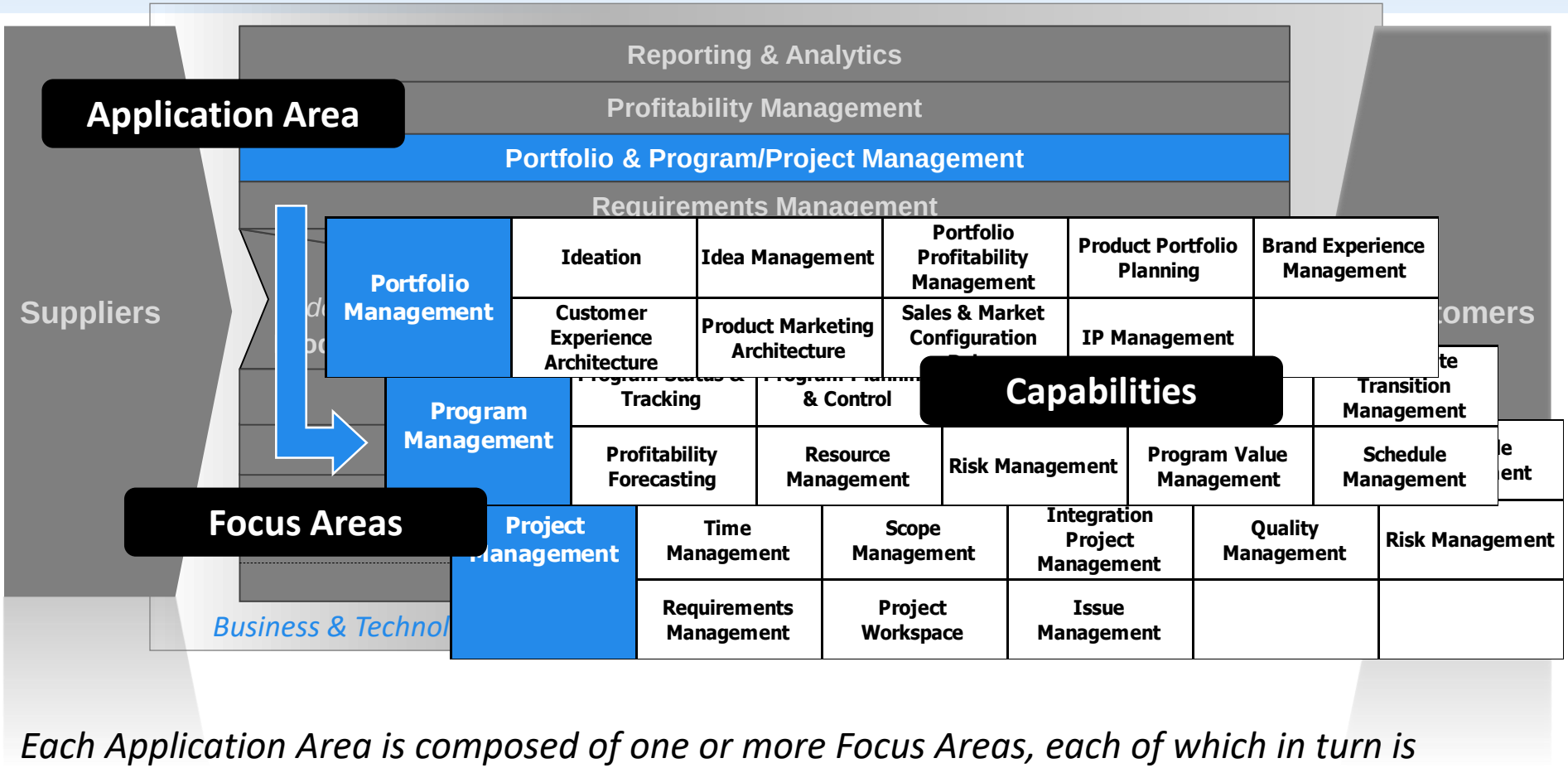
CIMdata's EAA: An Assessment Model

Enterprise Application Architecture begins with an Information Capabilities Model

- CIMdata's Enterprise Application Architecture (EAA) describes a comprehensive Enterprise Application Architecture Model
- It has been defined in terms of information capabilities that are defined and directed by the organization's Business & Technology Platform
- The information capabilities are processes and technologies (i.e., functional capabilities) that are used to perform a business function
- In general, input into the enterprise application architecture or framework is from an organization's suppliers and the output is to its customers

Enterprise Application Architecture™

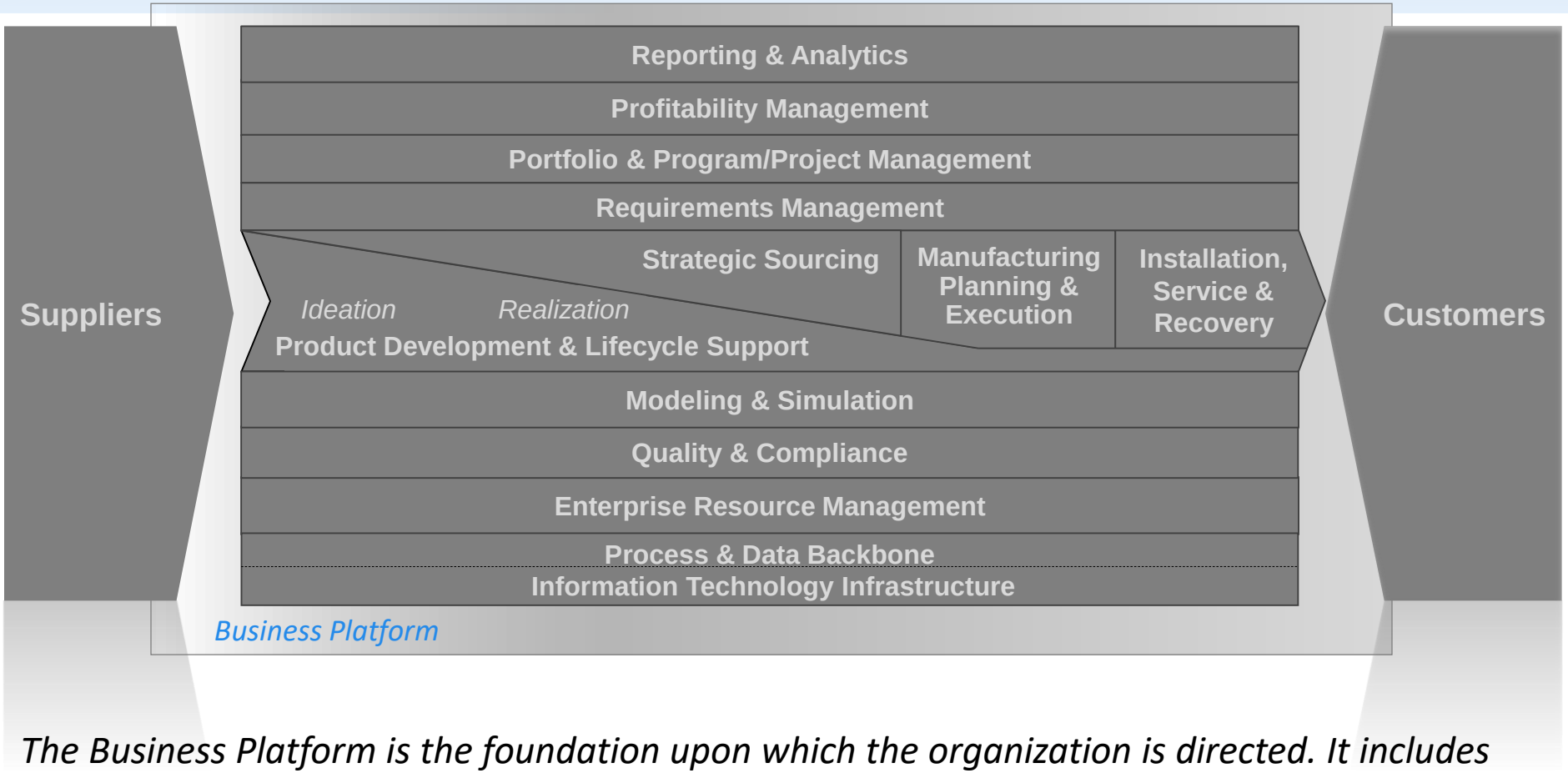
Enterprise Application Architecture Capabilities Framework



Each Application Area is composed of one or more Focus Areas, each of which in turn is composed of a set of related information capabilities.

Enterprise Application Architecture™

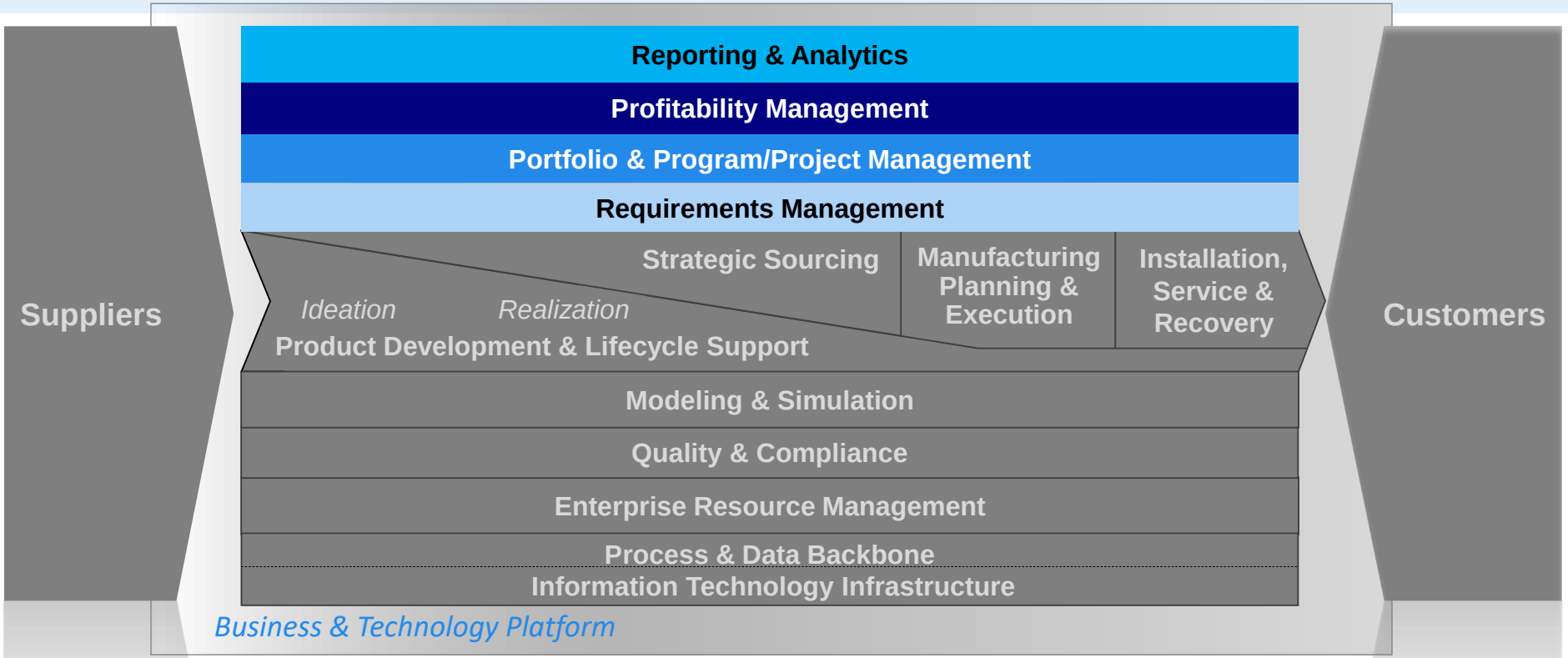
Enterprise Application Architecture begins with an Information Capabilities Model



The Business Platform is the foundation upon which the organization is directed. It includes business regulations, mission statement, core values & beliefs, strategic business plan, organizational policies, operating standards, governance, etc.

EAA: Business Transformational Capabilities

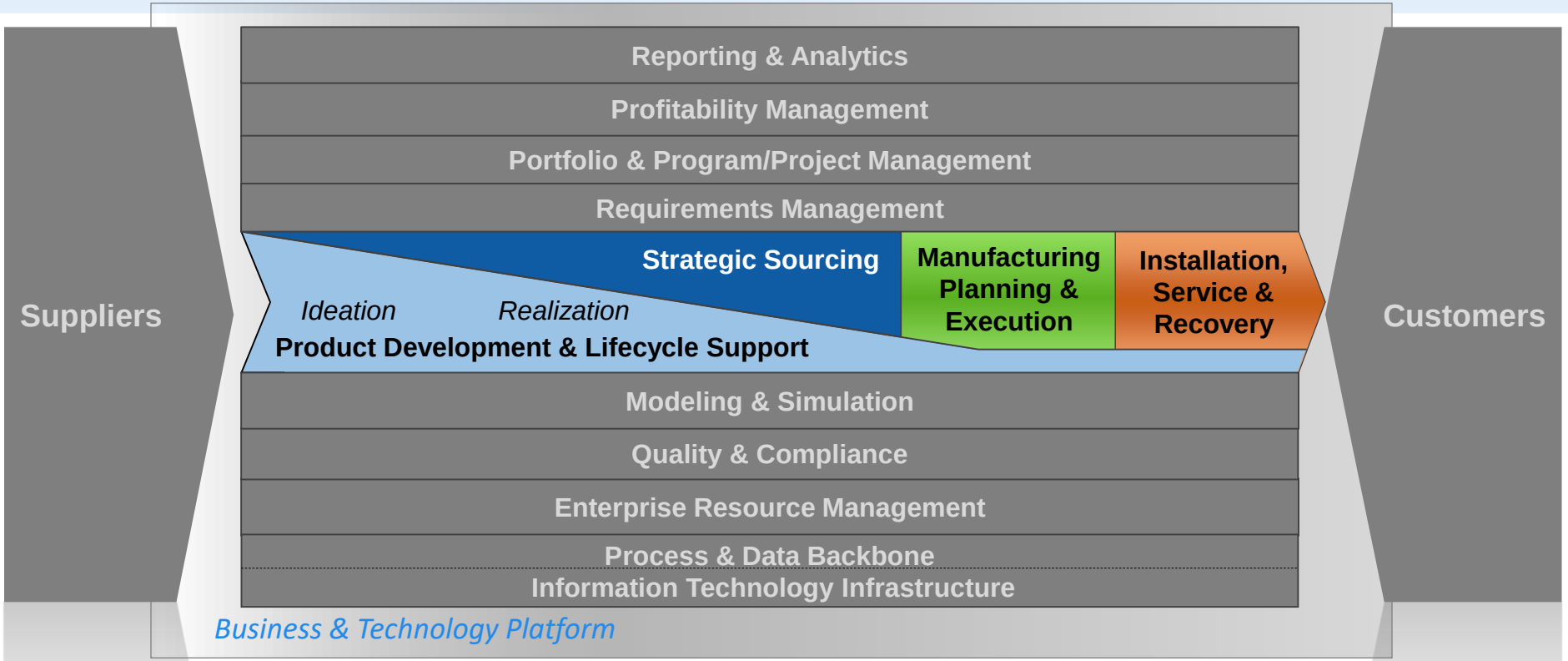
Information access, reporting, and guidance form the upper portion of the stack



- Universal access to all information produced by the organization
- Information is structured, found, and manipulated to derive insight
- The organization is guided by lifecycle profitability and portfolio management
- Requirements lead and the product follows

EAA: Value Chain Capabilities

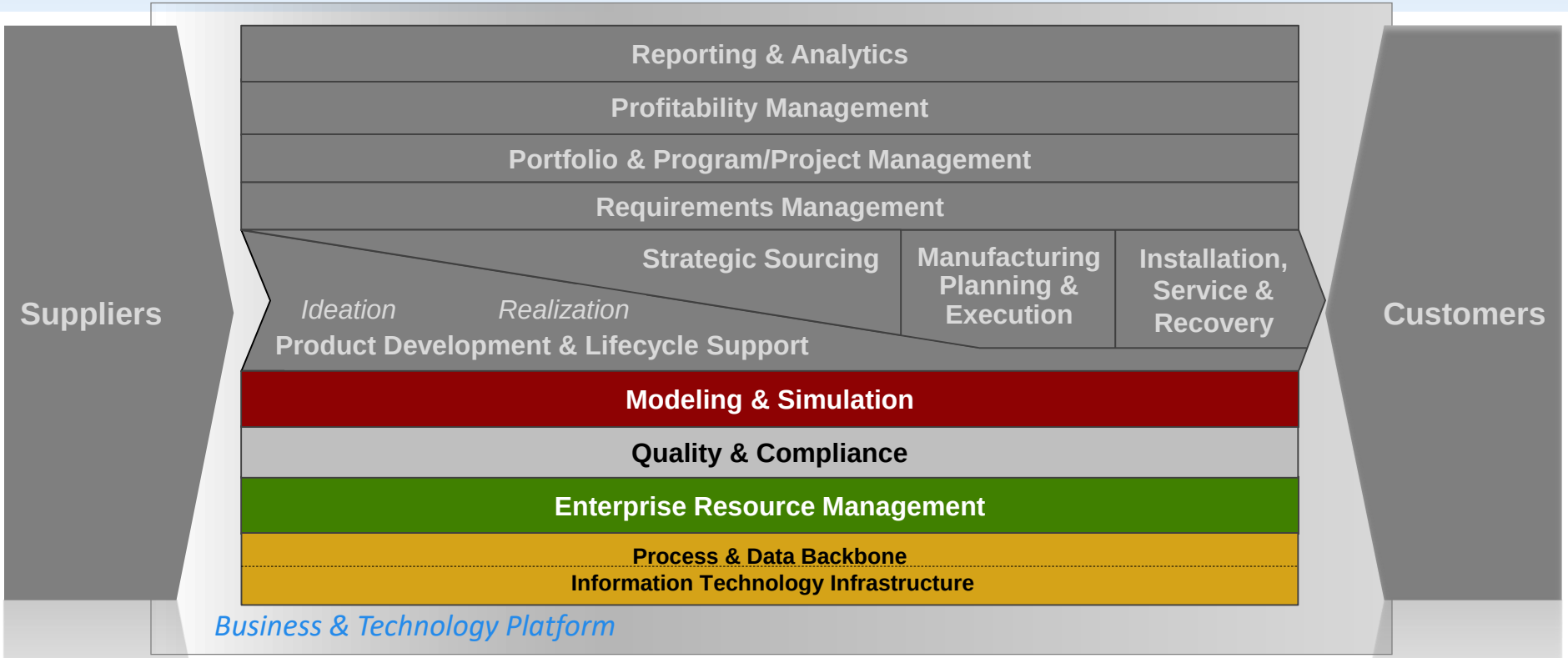
The value chain develops, manufactures, delivers, and services products



- Tools to create and capture all product, sourcing, supplier, customer, manufacturing, and field service information produced by the business
- Product configurations, product architecture, and BOMs are developed & maintained
- Selection and integration of mechanical, electronic, and software components into a system/service and/or specifications, ingredients, formulas, and recipes

EAA: Foundational Enterprise Capabilities

The core capabilities support the value chain



- Modeling and simulation across the lifecycle and among all disciplines
- Collection and management of quality information to manage warranty costs
- Ensure compliance to customer, state, federal, and other governmental regulations
- Management of financial, human resource, sales, and customer data
- Information Infrastructure including servers and information services

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A Review of In-Scope Capabilities

A live review of CIMdata's EAA framework and MBSE-enabling capabilities

Enterprise Application Architecture			MBSE In-Scope Capabilities		
Updated:	Release 21		*enter data **only** in light green highlighted cells on each tab*		
Focus Areas	***Enterprise Information Capabilities***				
Reporting & Analytics	**Automated Reporting**	**Crawling & Indexing**	**Custom Analytics**	**Executive Dashboard**	**Search & Find**
	Predictive Analytics	**Statistical Modeling**	**Data Visualization**	**Drill Down & Expand Up**	**Data Acquisition & integration**
Profitability Management	**Market Identification**	**Market Forecasting**	**Product Forecasting**	**Product Portfolio Forecasting**	**Revenue Forecasting**
	Cost Forecasting				
Portfolio Management	**Ideation**	**Idea Management**	**Portfolio Profitability Management**	**Product Portfolio Planning**	**Brand Experience Management**
	Customer Experience Architecture	**Product Marketing Architecture**	**Sales & Market Configuration Rules**	**IP Management**	

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CIMdata's EAA Maturity Assessment

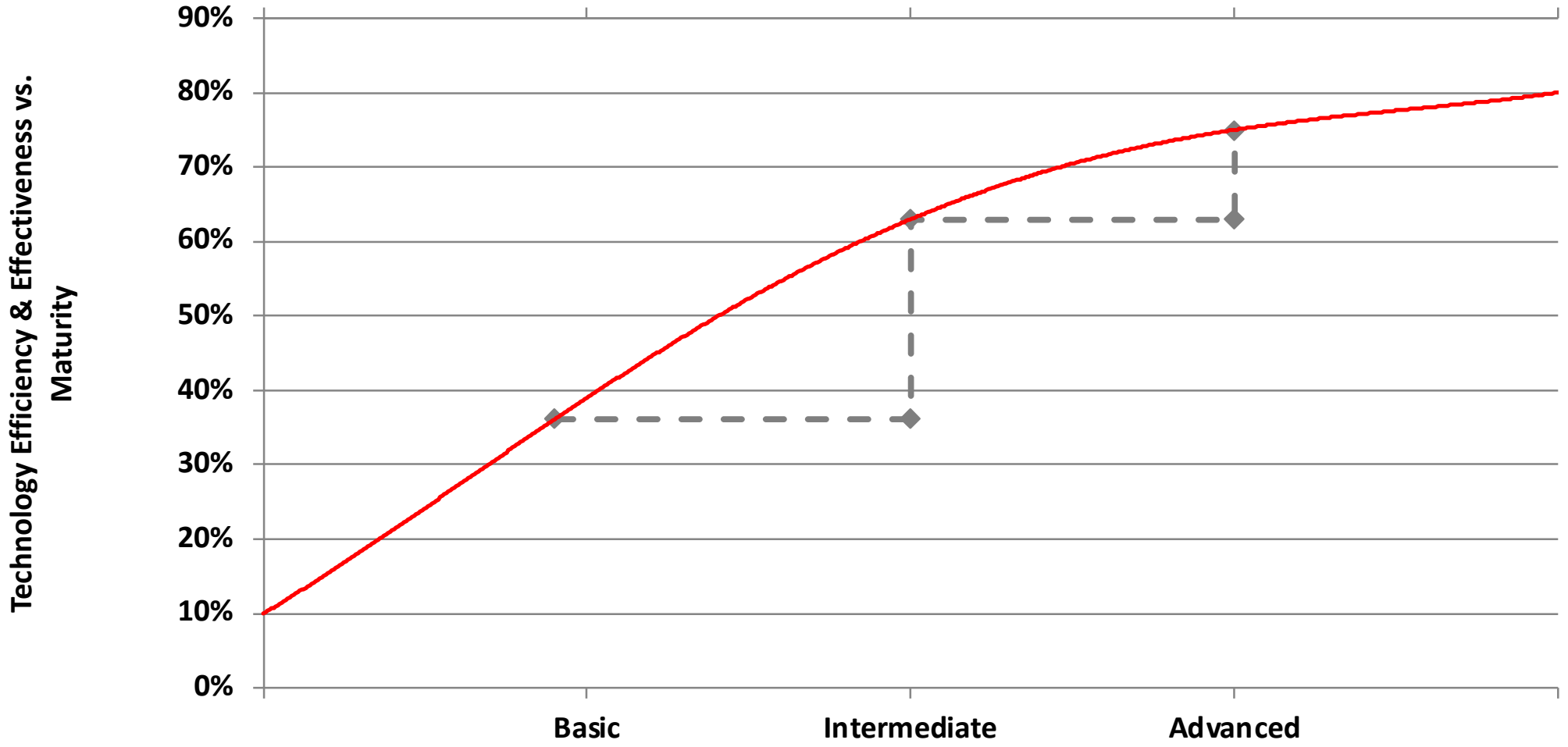
*A structured approach to assessing an organization's current state of EAA maturity in specific Focus Areas**

- The maturity assessment tools employed:
  - *Company assessment surveys*: determine the maturity of each capabilities in-scope
  - *Key elements*: a set of predefined primary characteristics that are assessed
  - *Definition of maturity levels matrix*: establishes the mapping between the key elements for a given assessed element and each maturity level (see below)

Maturity Level	Definition
Basic	The capability is used for increasing *individual* productivity. However, the capability is under-utilized and inefficiently applied. There is minimal use and/or enablement of the capability.
Intermediate	The capability is used for increasing *group* effectiveness only moderately and/or some of the time.
Advanced	The capability is regularly used and is kept current. There is a conscious effort to assimilate the capability into the work culture. The capability is used to facilitate, support, and mediate work at the *appropriate organizational level*.

CIMdata's EAA Maturity Assessment

Standard Technology Efficiency & Effectiveness vs. Maturity curve



Requirements Management

Description

- Fundamentally, these capabilities enable the process of documenting, analyzing, tracing, prioritizing, and agreeing on requirements, then controlling change and communicating to relevant stakeholders
- Please note that requirements management is a continuous process throughout a project and across the lifecycle of products

Requirements Management

Capabilities defined (1 of 2)

- *Investigation*—This capability supports the gathering of customer, business, governmental, and development team requirements (i.e., what do they want the product or portfolio of products to do—the voice of the customer)
- *Feasibility*—This capability allows the cost of achieving the managed requirement to be determined
- *Design*—This capability is used when the costs are determined to be accurate and the benefits to be gained are determined to be sufficiently large
- *Optimization*—This capability leverages modeling & simulation to analyze trade-offs among competing requirements to determine the best set of requirements for a given product and its associated markets
- *Construction & Test*—This capability is used to ensure that work and cost stay within schedule and budget, and that the emerging design meets specific requirements, including all applicable regulations

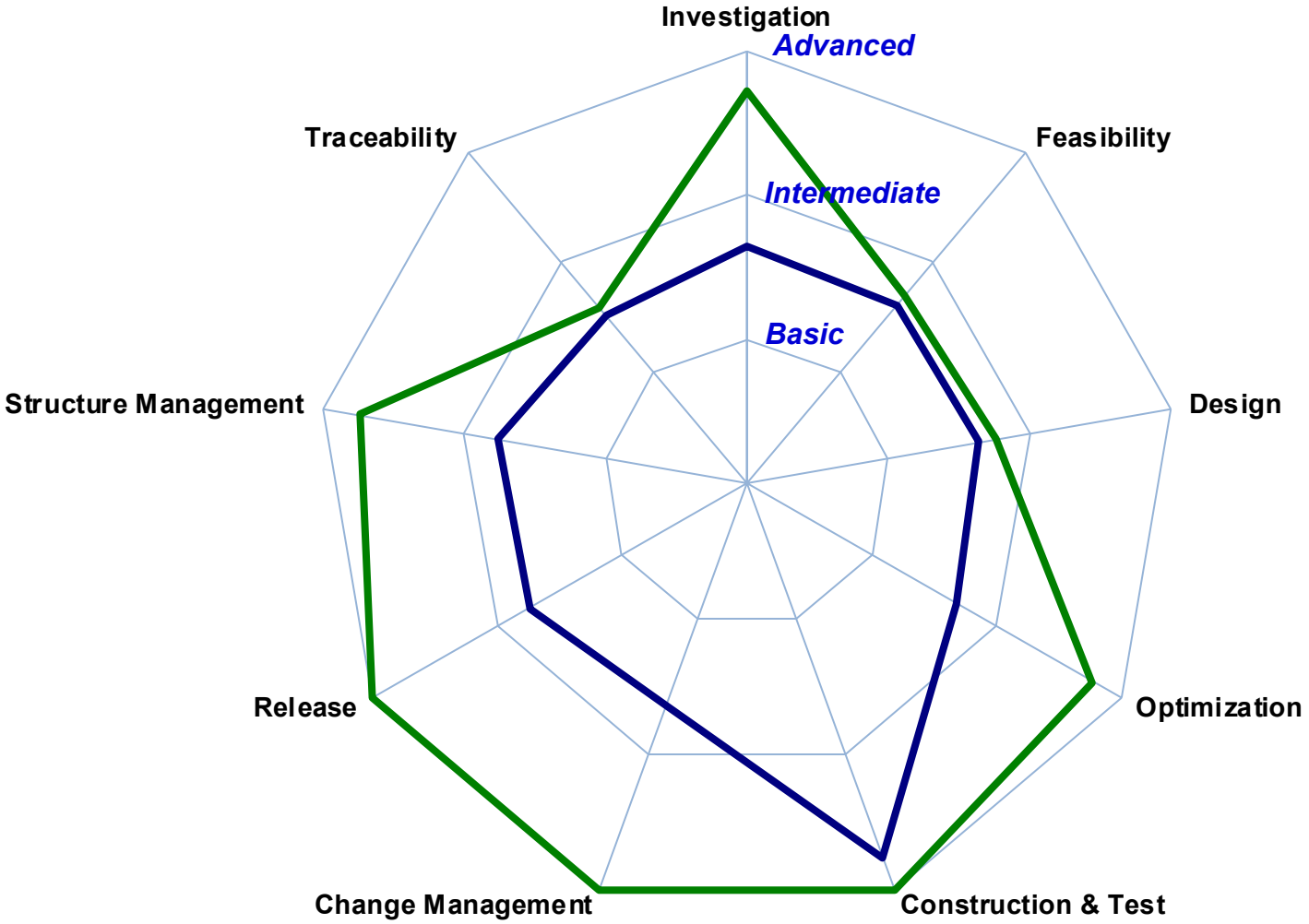
Requirements Management

Capabilities defined (2 of 2)

- *Change Management*—This capability manages changes to requirements throughout the lifecycle of the product and/or requirement itself (e.g., a legal or governmental requirement has a lifecycle of its own)
- *Release*—This capability ensures that the set of approved requirements or approved changes to previously released requirements are clear, concise, and valid
- *Structure Management*—The capability that defines how to create, expand, reconfigure, and augment the requirements-organizing framework (i.e., structure) for assignment of identities and relationships among the requirements that constitute a product's or set of products' operational criteria
- *Traceability*—This capability uses a requirements structure's links to ensure that requirements relationships are valid, and that each level of requirements are in fact appropriately met by the proposed design

Example: Requirements Management Maturity

Current Focus Area maturity assessment results based on complete responses



Blue curve = current state | Green curve = if all "some of the time" was "all the time"

Observations:

- Eight of the nine in-scope capabilities display a Basic to Intermediate level of maturity
- The Construction & Test capabilities displays a high level of maturity, but Traceability is very low & must be addressed
- If additional discipline and/or enablement is applied, higher levels of maturity would be reached in six of the nine in-scope capabilities

Systems Engineering

Description

- This Focus Area applies a formal methodology to integrate, verify, and validate the mechanical, electronic, software, and other components of a product and/or service based on requirements

Systems Engineering

Capabilities defined (1 of 2)

- *Platform Architecture Management*—This capability enables the process of defining and maintaining a base architecture or framework of a product
- *Modeling & Simulation*—This capability enables the use of models, including emulators, prototypes and stimulators, either statically or over time, to develop data as a basis for making managerial and technical decisions
- *Requirements Management*—This capability defines how customer and internal needs, wants, and desires are captured and communicated to the organization
- *Functional Allocation*—This capability enables the allocation of behavior and performance requirements to architectural elements of the product structure
- *Hardware/Software Integration*—This capability enables the process of bringing together software (e.g., embedded code) and hardware (e.g., processor) components into a system and ensuring that the assembly can be managed, verified, validated, produced, and delivered as an integrated entity

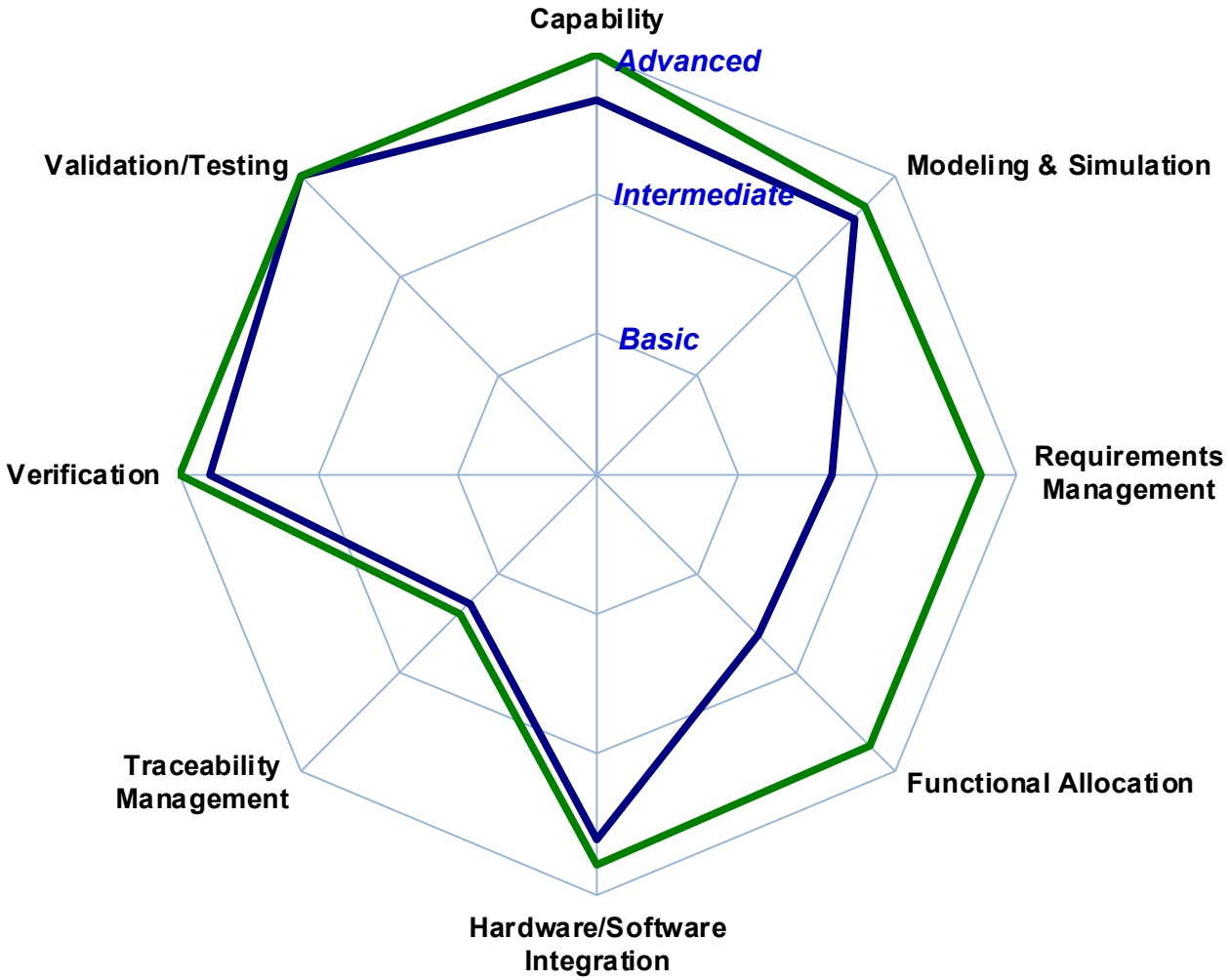
Systems Engineering

Capabilities defined (2 of 2)

- *Traceability Management*—This capability provides the ability to assign derivative or dependency relationships between elements of the Bill of Information and to query on these relationships
- *Verification*—This capability enables procedures that are used for virtually checking that a product, service, or system meets all applicable requirements and specifications, as well as fulfills its intended purpose
- *Validation/Testing*—This capability enables procedures that are used for physically checking that a product, service, or system meets all applicable requirements and specifications, and that it fulfills its intended purpose

Systems Engineering Maturity

Current Focus Area maturity assessment results based on complete responses



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Observations:

- The systems engineering maturity across five of the eight in-scope capabilities are at or are close to being at the highest maturity level (Advanced)
- If additional discipline and/or enablement is applied, higher levels of maturity would be reached in four of the eight in-scope capabilities
- Traceability lacking here as well

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Concluding Remarks

Assessing PLM's Capabilities in Support of MBSE

- MBSE enablement requires a holistic and integrated application approach—one that supports a business' strategy & business objectives, while maximizing their return on investment
- CIMdata's EAA is an example of a comprehensive enterprise information capabilities model that can be used to assess MBSE enabling capabilities
- Identifying & assessing an organization's required MBSE enabling capabilities is multi-faceted, with capabilities cutting across data & process mgt. areas
- CIMdata's EAA capabilities model can also be used to define requirements and implementation plans
- CIMdata's EAA capabilities model will continue to evolve to meet tomorrow's challenges and needs

Questions & Answers

CIMdata

Strategic consulting for competitive advantage in global markets

World Headquarters
Ann Arbor, Michigan USA
Tel:+1.734.668.9922

Main Office - Europe
Weert, NL
Tel:+31 (0) 495.533.666

Main Office - Asia-Pacific
Tokyo, JAPAN
Tel:+81.47.361.5850

www.CIMdata.com

Serving clients from offices in North America, Europe, and Asia-Pacific